SECRET

28 April 1960

OXC-0520-60

MEMORANDUM FOR: The Record

SUBJECT : Trip Report - Pratt & Whitney, Florida R & D Center
19 through 21 April 1960

1. Subject facilities were visited by the writer for the purpose of reviewing current and potential engine/airframe problems, the results of which are summarized as follows:

(A) Gearbox: An electrical power problem has existed whereby engine speed during airplane descent was below the minimum required for alternator output. This problem has been resolved by a design change in gear ratio compatible with minimum alternator requirements.

(B) Pyrophoric Ignition Cartridge: A potential handling problem exists during replacement of the ignition cartridge after each flight because of the pyrophoric qualities of the ignitor, triethylborane. Concern for this potential hazard as previously expressed by Lockheed was tempered somewhat by a demonstration presented for and viewed by the Lockheed Chief of Flight Test for the OXCART project. The reactions upon completion of the demonstration were that this system by its necessity will be acceptable and that extraordinary precautions in handling will be required on the part of all concerned.

(C) Engine Lubricating Oil: Concern has been expressed by Lockheed for the relatively high environmental temperature required for engine starts made in conjunction with the proposed oil. The minimum pour point temperature of the oil is +40°F. For engine starts at environmental temperatures below +45°F, the engine oil either must be preheated to +45°F or be diluted with a dichloromethane additive which will bring the acceptable pour point temperature down to -60°F. The operational requirements established by this condition are under current discussion between Lockheed and Pratt & Whitney.

(D) Environmental Weather: As expressed in a recent Lockheed progress report, mission altitude temperatures are expected to run somewhat colder than previously anticipated and pressure altitudes at a constant tapeline altitude may vary as much as 8,000 to 10,000 feet. Whereas temperatures higher than anticipated would reduce engine output, temperatures somewhat lower than anticipated will not have a deleterious affect on engine performance. Pressure altitude variations as described above will not deleteriously affect engine operation as such provided the engine design limit of M.2 @ 100,000 ft. pressure altitude is not exceeded. If the airplane maintains a constant pressure altitude, there will be no pressure variation relative to the airplane or the engine. If, however, an attempt is made to maintain a constant tapeline altitude, then the engine will schedule itself to operate at the changed inlet conditions corresponding to the new pressure altitude thereby establishing the specific fuel consumption for that altitude. This uninstalled engine performance parameter then may vary approximately 2.5 to 3 per cent for an 8,000 to 10,000 ft. pressure altitude variation in the mission flight regime. Aircraft installed engine performance will be more markedly affected by the pressure altitude variations because of their effect upon inlet recovery which in turn will tend to magnify the uninstalled engine specific fuel consumption variation and in addition will affect thrust. Aircraft systems, of course, will be affected by the lower than anticipated temperatures in that the systems will have to be designed for the lower temperatures. General aircraft performance effects, although undoubtedly present, are considered beyond the scope of this report.

Non standard day engine performance data are now being transmitted from P & W to Lockheed for aircraft propulsion performance evaluation.

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(E) Fuel: Fuel is currently being delivered by [redacted] at a unit cost of 23¢/gal. based upon a volume of 4,000,000 gal./year. This fuel is in accord with the target specification PWA-523 except for minimum heating value which is running between 18,750 to 18,837 BTU/lb. rather than 18,900 BTU/lb. per spec. It is expected that by 1961 the spec. requirement of 18,900 BTU/lb. min. will be met with a tolerance spread of +200 BTU/lb. This means that certain batches depending upon the crude should yield 18,900 + 200 or 19,100 BTU/lb.

It is P & W's feeling that no major problems now exist in this area, and that project/refinery contact is unnecessary. Price has become reasonable; heating value is approaching spec., thermal stability, viscosity, luminosity, vapor pressure, distillation, specific gravity, and corrosion are all within spec. The need for increasing the market by generating outside interest is felt to have lessened as evidenced by the lack of current effort in this area. In addition to the decrease in necessity, the reason set forth for this lack of effort is the difficulty in selling a commodity the advantages of which are overbalanced by cost.

It is the writer's feeling that a continuing effort should be made in the area of interest generation for the purpose of realizing lower unit costs resulting from increased volume and for the purpose of realizing possible performance improvements resulting from the additional consumer pressures characteristic of a larger market. Further, it is recommended that P & W be requested to revise or supplement the present spec. PWA-523 to include a requirement that at least a certain percentage of the 1961 deliveries have a heating value of 19,100 BTU/lb.

P & W has been asked to review the "interest generation" concept and the outlook for firm 19,100 BTU/lb. heating value commitments with [redacted] at their earliest convenience.

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(F) Engine Moves: P & W's feeling for the procedure in moving engines to the Coast is to truck the engines to West Palm Beach Airport where they would be loaded into a project aircraft for flight to the Coast. Shipping papers could be prepared which would terminate P & W Florida interest or follow-up at West Palm Beach and show a final destination of E. Hartford or other appropriate point.

(G) Engine Schedule: Certain details of the engine delivery schedule were clarified which together with the basic schedule reveal a potential shortage of spare engines during the flight test program. P & W is willing to consider revision to the engine schedule as required. This condition will be followed and expanded by the writer and will be covered by a separate memorandum.

(H) Exhaust Gas Ionization Additive Program: A realistic and positive effort continues for the resolution of the problems involved in this program. Sea level tests with the J-57 engine (recently modified to approximate altitude exhaust gas temperatures) continue. Altitude testing is scheduled at E. Hartford for 15 May. Major areas of investigation are summarized as follows:

(1) Additive Flow Rate: Current sea level tests when corrected to altitude mass flow and density are yielding metal flow rates of 8 to 34 lbs./hr. @ 100% A/B and 150 to 800 lbs./hr. for the lower temperatures @ 70% A/B. This constitutes a required flow variation of 8 to 800 lbs./hr. which represents improvement but is still far from acceptable. It is expected, with the isolation of certain known errors such as those associated with static temperature determination, that this variation will decrease markedly.

(2) Metal Carrier: [redacted] reports indicate favorable progress in the development of an organic carrier with a solubility of 20% cesium by weight, with acceptable miscibility with fuel, and with acceptable heating value and vapor pressure.

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Effort is being expended also in the direction of slurrys because of their higher metal concentration capabilities (50% metal by weight). This means less pounds of dead weight carrier per pound of metal.

(3) Control: Preliminary design has been initiated for the additive flow control based upon a "turn-down" ratio of 100/1 which corresponds with the current metal flow rate variation ratio of 800/8. Detail design will be dependent upon E. Hartford altitude test results.

(4) Temperature Measurement: The most promising avenue toward accurate static temperature measurement appears to be that of the Sodium Line Reversal System developed by NASA specifically for use with jet engines. This system is based upon the principle of spectrographic analysis. Equipment is being gathered now for evaluation of the system.

(I) Engine Test Facilities: Facilities completion is running close to schedule and is fully compatible with current production schedules. The D-20 compressor is now temporarily on test in E. Hartford until shakedown completion on the altitude compressor stand here. The complete D-20 engine is scheduled for test in August.

(J) Hydraulic System: Inasmuch as the engine hydraulic system utilizes fuel rather than hydraulic oil, there exists no interest in the new low temperature pour point fluid mentioned in a recent Lockheed report for this program.

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[redacted]
Development Branch
DPD-DD/P

DEV BR/DPD/ROD/mjw
28 April 1960
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